REMARKS

Claims 19-39 are now in the application. Claim 29 has been amended for purposes of clarity by deleting the comma between "propylene" and 'carbonate" and not to limit its original scope.

Claims 19-24, 26-27, 32-33 and 37-38 were rejected under 35 USC §102(b) as being anticipated by U.S. Patent 5,770,103 to Wang et al. (hereinafter also referred to as "Wang"). Wang does not render obvious the present invention. By way of background, the present invention relates to a method for polishing a surface and especially those surfaces employed in microelectronics. The method of the present invention employs a slurry composition that is capable of polishing both metal and silicon dioxide at substantially equal rates (see page 1, lines 7-9). The slurry compositions employed in the method of the present invention comprise abrasive particles and an oxidizing agent having a static etch rate on metal of less than 1000 Å per hour and having a pH of about 5 to about 11.

As discussed in the specification, the present invention provides a method that is capable of removing the topography and scratches created during the polish of a prior level of metallization.

The slurries employed pursuant to the present invention differ significantly from slurries that are presently utilized for either tungsten or oxide polishing. The slurries that are used for tungsten polishing are generally specifically formulated to not polish the dielectric; that is, they are selective to the oxide. Generally, they are acidic, employing aluminum oxide as the abrasive, having a pH in the range of 1 to 4. When utilized to reduce topography for this application, such slurries leave the surface scratched, with the tungsten conductors considerably recessed. In contrast, use of a typical oxide slurry, which is generally a silica particle with pH in the range of 10 to 12, eliminates the scratches caused by the primary slurry, but is highly selective to the tungsten. That is, it does not polish the tungsten. Thus, by the time that the scratches and erosion are eliminated by this polishing slurry, the tungsten is protruding above the dielectric by an amount that is equivalent to the amount of oxide removed.

Received from < 2022936229 > at 10/8/03 1:23:55 PM [Eastern Daylight Time]

On the other hand, use of the slurries according to the present invention addresses problems discussed above. (See page 7, line 20 - page 8, line 24; and page 3, lines 18-24).

In the manufacture of a semiconductor device, the wires for the chip in the "back end of the line" (BEOL) are usually formed by the so-called cloisonné process. In this process, the metal is uniformly deposited on the wafer, patterned with a mask, and then etched with a plasma reactive ion etch (RIE) tool to leave the metal isolated in regions where one desires the wires. Then the dielectric material is deposited, and polished using chemical mechanical planarization (CMP) to leave the conductors properly separated. One of the benefits of this process of forming the wires is that since the plasma RIE removes material on a "line of site", it is effective in removing the metal that might be deposited in topography that originated from a process operation at a prior level.

However, to both reduce cost and to utilize different, low-resistance materials for the construction of the metal wires, the cloisonné process is being replaced by the damascene process to form the wires in the BEOL. In this reverse process, the dielectric is first uniformly deposited, patterned with a mask and etched. Then the metal conductor is uniformly deposited such that it forms a conformal film over the entire wafer and fills the patterns that have been etched into the dielectric. Then, using CMP, the excess surface metal is removed to leave the wires filled with metal. One of the problems with this process is since the metal is removed via CMP, which planarizes as it removes the excess material, residual metal can remain in topography that has been created at prior levels. That is, if there is a scratch or erosion in the dielectric, the metal will fill that void and cannot be removed easily via CMP without considerable over polish and the resulting damage that it introduces.

A specific example where this change in methodology of creating the wires is necessary is the manufacture of semiconductor devices with copper BEOL wiring. Since there is no viable process for etching copper currently available, it is a preferred technique to form the lines with the damascene process. In such a case, the local wiring of the semiconductor devices (that is at the lowest levels of the chip), usually utilizes tungsten as the conductor, which is then connected

to the more global wiring in the BEOL, which is made of copper. In this specific example, it is found that erosion or scratching of the oxide dielectric at the last tungsten level replicates up and to the ensuing copper levels. The areas of erosion then lead to "puddles" of residual copper, and the scratches leave "stringers" of the copper, each of which if not removed at the copper CMP step would cause short-circuits. If these puddles or stringers are removed during the copper CMP step, it adds considerable processing time for the "overpolish."

Since the removal of all of the surface metal is essential to eliminate the short circuits and because the damascene process is sensitive to both the material and underlying topography of those materials, it is clear that the surface of the wafer must be highly planar (i.e., no existing topography) prior to the deposition of the metal. The obvious method of achieving this polarity is to polish the dielectric into which the metal will be inlaid to create a smooth, scratch-free film prior to metal deposition. However, this has the disadvantage that it would necessitate additional process steps (polishing and cleaning) and would result in a highly variable dielectric, and hence, conductor thickness. This would cause the undesirable result of having a variable resistance for the circuit.

The present invention overcomes problems in the prior art. More particularly, as discussed above, the present invention employs a slurry composition that is capable of removing the topography and scratches created during the polish of a prior level metallization. The slurry composition employed according to the present invention, as discussed above, can polish both metal and silicon at equal or substantially equal rates.

Wang fails to anticipate the present invention, since among other things, Wang fails to suggest selecting a pH of about 5 to about 11 along with selecting an oxidizing agent having a static etch rate on metal of less than 1000 Å per hour. On the other hand, Wang suggests employing a slurry having a pH of 1 to about 7 and employing an oxidizing agent such as nitrates, iodates, chlorates, perchlorates, chlorites, sulphates, persulphates, peroxides, ozonated water and oxygenated water. Many of these oxidizing agents such as ferric nitrate, ammonium persulfate and hydrogen peroxide exhibit etch rate significantly greater than that recited in the

claims. Moreover, none of the examples in Wang employ a slurry composition having a pH of at least about 5 along with an oxidizing agent having a static etch rate or metal of less than 1,000 Å per hour. The examples in Wang have a pH of 4 or about 3.5. It has been found according to the present invention that both the pH and type of oxidizing agent, are judiciously selected in order to achieve the results obtainable by the present invention and namely to obtain polishing of both metal and silicon dioxide at equal or substantially equal rates.

On the other hand, the polishing compositions and technique suggested by Wang result in achieving much higher metal etching rates. In fact, the objective of Wang is to achieve very high polishing rates for metal as contrasted to the results obtainable by the present invention. The objective of Wang is to provide a slurry for removing titanium and other metals while suppressing the rate of removal of silicon (for instance, see column 3, lines 1-7 thereof). To etch metal and silicon dioxide at substantially the same rate would be contrary to the desires of Wang.

As discussed, nothing in Wang leads to employing a composition having the same abrasive, oxidizing agent, and pH as recited in the present claims from all of the possible combinations suggested by Wang.

The law is well settled that claiming of a more specific range within a more generic range and/or claiming species from a broader group of possible compounds avoids the invention from being exactly the same as the prior art. The test employed is whether the claims read on the prior art disclosure, not on what the references broadly teach.

For example, see *Akzo N.V. v U.S. International Trade Commissioner*, 1 USPQ2d. 1241 (Fed. Cir. 1986). In *Akzo*, claims that were drawn to a process for making aramid fibers using a 98% sulphuric acid were not anticipated by reference using a concentrated sulfuric solution but which did not specifically disclose that it was a 98% concentrated sulfuric acid solution.

The Court further found that no anticipation exists when one would have to "randomly pick and choose a number of different polyamides, a plurality of solvents and a range of inherent viscosities" to reach the claimed invention.

In *Rem-Cru Titanium v. Watson*, 112 USPQ 88 (D.D.C.-1956), the prior art showed alloys having broad ranges which included the claimed ranges. However, the prior art did not specifically disclose the more limited claimed ranges or alloys having the characteristics of the claimed alloy, which is analogous to the present case. Accordingly, the Court held the claims to be allowable. For a similar fact pattern and same holding, please see *Becket v. Coe* (CA, DC 1938) 38 USPQ2 and *Terak v. Watson* (DC-DC 1954) 103 USPQ 78. Also, see *Minnesota Mining & Manufacturing Co. v. Johnson & Johnson Ortho-Paedics, Inc.* (24 USPQ2d, 1321 Fed. Cir. 1992). Here the Court held that although the claims may be subsumed in a prior art reference generalized disclosures, this is not literal identity. The reference ranges provided no guidelines on how to construct a product with the inventions attributes.

An invention cannot be rejected based on inherency because of probability of possibilities of the presences of the constituents in the prior art. *See Crown Operations International, Ltd. v. Solutia*, 24 USPQ2d 1917 (Fed. Cir. 2002).

Inherency requires that the recited results or structure must necessarily be obtained not merely that it might be achieved. See *Electra Medical Systems S.A.* v. *Cooper Life Sciences, Inc.*, 32 USPQ2d 1017 (Fed. Cir. 1994); *In re Oelrich*, 212 USPQ 323 (CCPA 1981) and *In re Robertson*, 49 USPQ2d 1949 (Fed. Cir. 1999).

Claims 19-25, 28-31 and 34-36 were rejected under 35 USC §102(e) as being anticipated by U.S. Patent 5,804,518 to Sakatani, *et al.* (referred to herein as "Sakatani"). Sakatani does not anticipate the above claims. In particular, Sakatani fails to suggest a method for polishing that employs an oxidizing agent having a static etch rate on metal of less than 1000 Å per hour and also having a pH of about 5 to about 11 as recited in the present claims. As discussed above, in order to obtain polishing rates that are substantially equal between metal and silicon dioxide, above-pH of the slurry and oxidizing agent are judiciously selected. On the other hand, Sakatani suggests employing a pH of about 7 or less or preferably about 5 or less along with an oxidizing agent which can be hydrogen peroxide, iron (III) nitrate, iodic acid, iodate, perchloric acid and perchlorate. The preferred oxidizing agents are hydrogen peroxide and iron (III) nitrate.

Included among the oxidizing agent such as the hydrogen peroxide and iron (III) nitrate are those that have polishing rates on metals significantly greater than the 1000 Å per hour recited as a maximum in the claims. In addition, none of the examples in Sakatani employ a pH of at least about 5 along with an oxidizing agent having a low static etch rate of less than 1000 Å per hour as recited in the claims. The only examples in Sakatani employing a pH of above 5 are examples 4 and comparative example 8, both of which employ hydrogen peroxide, a strong oxidizer, as the oxidizing agent (for instance, see page 7, line 27-29 of the specification). Moreover, the objective of Sakatani is to have high etch rates for the metal as compared to silicon dioxide. Along these lines, see tables 1 and 2 of Sakatani. Accordingly, to include the slurry compositions employed according to the present invention would be contrary to the objectives of Sakatani. Nothing whatsoever in Sakatani would leave one skilled in the art to select a slurry composition having a pH of at least 5 and an oxidizing agent having a static etch rate on metal of less than 1000 Å per hour among all the possible combinations of pH and oxidizing agents suggested in Sakatani. If anything, one skilled in the art would be lead to employ an oxidizing agent having an etch rate on metal as high as possible since that is an objective of Sakatani.

The cited references fail to anticipate the present invention. In particular, anticipation requires the disclosure, in a prior art reference, of each and every recitation as set forth in the claims. *See Titanium Metals Corp. v. Banner*, 227 USPQ 773 (Fed. Cir. 1985), *Orthokinetics, Inc. v. Safety Travel Chairs, Inc.*, 1 USPQ2d 1081 (Fed. Cir. 1986), and *Akzo N.V. v. U.S. International Trade Commissioner*, 1 USPQ2d 1241 (Fed. Cir. 1986).

There must be no difference between the claimed invention and reference disclosure for an anticipation rejection under 35 USC §102. *See Scripps Clinic and Research Foundation v. Genetech, Inc.*, 18 USPQ2d 1001 (CAFC 1991) and *Studiengesellschaft Kohle GmbH v. Dart Industries*, 220 USPQ 841 (CAFC 1984).

Application No.: 09/819,787 Docket No.: 20140-00281-US

In view of the above, each of the presently pending claims in this application is believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to withdraw the outstanding rejection of the claims and to pass this application to issue.

In the event that the Examiner believes an interview might serve to advance the prosecution of this application in any way, the undersigned attorney is available at the telephone number noted below.

The Commissioner is hereby authorized to charge any fees or credit any overpayment associated with this communication including any extension fees to Deposit Account No. 50-0510.

Dated: 10-8-03

Respectfully submitted,

By [signature]

Burton A. Amernick
Registration No.: 24,852
CONNOLLY BOVE LODGE & HUTZ LLP
1990 M Street, N.W., Suite 800
Washington, DC 20036-3425
(202) 331-7111
(202) 293-6229 (Fax)
Attorney for Applicant

RECEIVED
CENTRAL FAX CENTER
OCT 0 8 2003

OFFICIAL